ACTIVE INTEGRATED CIRCUIT TRANSPONDER AND SENSOR APPARATUS FOR TRANSMITTING VEHICLE TIRE PARAMETER DATA

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Cited documents:

US5181975
WO9214620
US4657289

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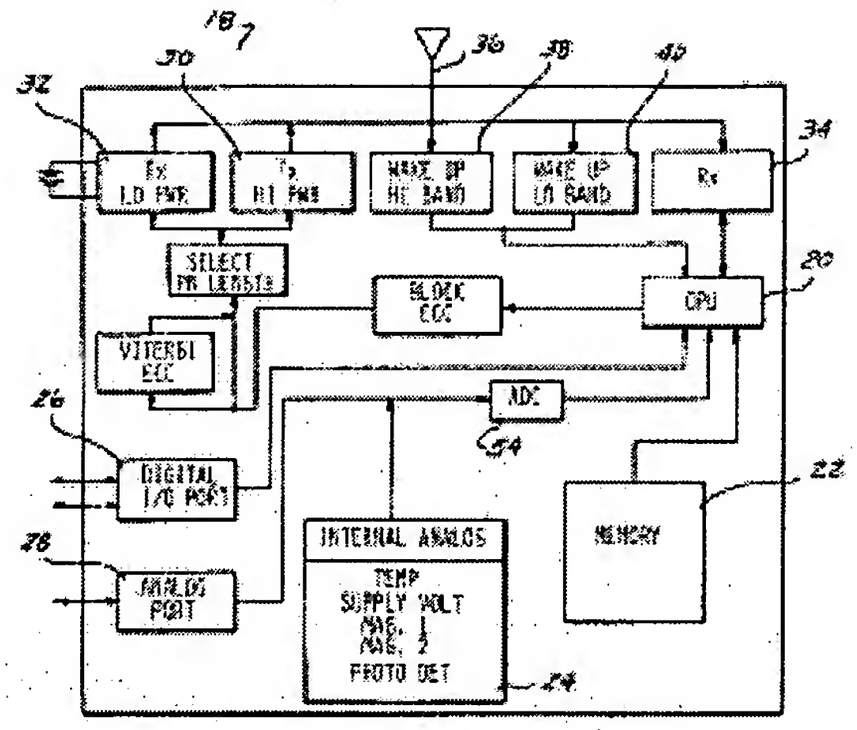
Abstract not available for EP0746475
Abstract of corresponding document: **US6087930**

An active integrated circuit transponder with on-board power supply is mounted in or on a vehicle tire. A pressure sensor, a temperature sensor and a tire rotation sensor are mounted on a substrate along with the integrated circuit transponder chip, the power supply and an antenna. Upon receiving an interrogation signal from a remote source, the transponder activates the sensors to sense tire pressure and temperature and transmits an encoded radio frequency signal to the remote source containing serial, encoded tire identification, tire position on the vehicle, current tire pressure, current tire temperature and accumulated tire revolutions, as well as maximum and/or minimum tire and temperature pressure values encountered over a predetermined time period and other information specific to the tire.



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SUPPLEMENTARY EUROPEAN SEARCH REPORT

Application Number
EP 95 90 9364

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
D,Y	US 5 181 975 A (POLLACK RICHARD S ET AL) 26 January 1993 * column 11, line 13 - line 30; figure 6 *	1-6, 10-14, 22, 25-27, 31,44, 50,51	B60C23/04
Y	WO 92 14620 A (TRUCK TECH CORP) 3 September 1992 * page 37, line 29 - page 39, line 3; claims 1,13; figures 6,12 *	1-6, 10-14, 22, 25-27, 31,44, 50,51	
P,Y	& US 5 335 540 A	1-6, 10-14, 22, 25-27, 31,44, 50,51	
A	US 4 657 289 A (BOYER ROBERT E) 14 April 1987 * column 2, line 41 - line 50; figures *	7,8	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B60C

The supplementary search report has been drawn up for the claims attached hereto.

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 February 1997	Hageman, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C04)

What is Claimed is:

1. In combination with a vehicle tire, a transponder for sensing, storing and transmitting vehicle tire condition parameter data comprising:

a substrate mountable on a vehicle tire;

an integrated circuit chip mounted on the substrate, the integrated circuit chip including a processor, a memory, a receiver means connected to the processor means for receiving an interrogation signal from a remote source, and a transmitter means connected to the processor means for transmitting a signal containing data representative of the sensed tire condition parameter to a remote source;

sensor means, mounted on the substrate, for sensing a tire parameter and for generating an output signal to the processor means representative of the sensed tire parameter;

power supply means, mounted on the substrate, for supplying electrical power to the integrated circuit chip and the sensor means; and

antenna means, mounted on the substrate and connected to the receiver means and the transmitter means, for communicating an interrogation signal from the remote source to the receiver means and for communicating a signal from the transmitter means to the remote source.

2. The transponder of claim 1 wherein the antenna means is a microstrip antenna mounted on the substrate.

3. The transponder of claim 1 wherein the antenna means is a patch antenna mounted on the substrate.

4. The transponder of claim 1 wherein the sensor means comprises:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted.

5. The transponder of claim 4 wherein the pressure sensor means comprises:

a pressure transducer and a pressure transmitting medium disposed in contact with the pressure transducer and exposed to an air chamber in a tire on which the transponder is mounted.

6. The transponder of claim 1 wherein the sensor means comprises:

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted.

7. The transponder of claim 1 wherein the sensor means comprises:

means, mounted on the substrate, for detecting and generating an output signal for each complete 360° revolution of a tire on which the transponder is mounted.

8. The transponder of claim 7 wherein the detecting means further comprises:

counter means, responsive to the output signal from the detecting means, for totalizing the output signals from the detecting means as an accumulated tire revolution count.

9. The transponder of claim 1 wherein:

the processor means monitors the sensor means to detect at least one of maximum and minimum values of a tire condition parameter over a predetermined time period.

10. The transponder of claim 1 wherein the receiver means and the transmitter means communicate with the remote source by a radio frequency signal.

11. The transponder of claim 10 wherein:

the processor means transmits a serial, encoded radio frequency signal containing tire condition parameter data via the transmitter means to the remote source.

12. The transponder of claim 1 further comprising:

a housing formed of an encapsulating material encapsulating the substrate, the integrated circuit chip, the power supply, the sensor means and the antenna means.

13. The transponder of claim 1 further comprising:

timer means, responsive to an activation signal from the processor means and connected to the sensor means, for activating the sensor means to sense a tire condition parameter only during a predetermined time period set by the timer means.

14. The transponder of claim 13 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal received from a remote source.

15. The transponder of claim 1 wherein the sensor means comprises at least one of:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted;

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted; and

means, mounted on the substrate, for detecting and generating an output signal for each complete 360° revolution of a tire on which the transponder is mounted.

16. The transponder of claim 15 wherein:

the pressure sensor means includes a pressure transducer and a pressure transmitting medium disposed in contact with the pressure transducer and exposed to an air chamber in a tire on which the transponder is mounted; and

the detecting means further comprises counter means, responsive to the output signal from the detecting means, for totalizing the output signals from the detecting means as an accumulated tire revolution count.

17. The transponder of claim 1 wherein the sensor means comprises:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted;

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted; and

means, mounted on the substrate, for detecting and generating an output signal for each complete 360° revolution of a tire on which the transponder is mounted.

18. The transponder of claim 17 further comprising:

timer means, responsive to an activation signal from the processor means and connected to the pressure sensor means and the temperature sensor means, for activating the pressure sensor means and the temperature sensor means to sense tire pressure and temperature, respectively, only during a predetermined time period set by the timer means.

19. The transponder of claim 18 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal from a remote source and transmits the sensed tire pressure and temperature and a total tire revolution count from the detecting means to a remote source during the time period established by the timer means.

20. The transponder of claim 18 wherein:

the processor means generates the activation signal separate from receiving an interrogation signal at a predetermined selectible time interval.

21. The transponder of claim 18 further comprising:

a housing formed of an encapsulating material encapsulating the substrate, the integrated circuit chip, the power supply, the sensor means and the antenna means.

22. In combination with a vehicle tire, a vehicle tire parameter sensing apparatus comprising:

control means having an interrogator transmitter means for transmitting an interrogation signal and a receiver means for receiving remotely generated signals;

a transponder mountable on a vehicle tire, the transponder including:

a substrate mountable on a vehicle tire;

an integrated circuit chip mounted on the substrate, the integrated circuit chip including a processor, a memory, a receiver means connected to the processor means for receiving an interrogation signal from a remote source, and a transmitter means connected to the processor means for transmitting a signal containing data representative of the sensed tire condition parameter to a remote source;

sensor means, mounted on the substrate, for sensing a tire parameter and for generating an output signal to the processor means representative of the sensed tire parameter;

power supply means, mounted on the substrate, for supplying electrical power to the processor means, the receiver means, the transmitter means and the sensor means; and

antenna means, mounted on the substrate and connected to the transmitter means and the receiver means, for communicating an interrogation signal from the control means to the receiver means and for communicating a signal from the transmitter means to the control means.

23. The apparatus of claim 22 wherein the antenna means is a microstrip antenna mounted on the substrate.

24. The apparatus of claim 22 wherein the antenna means is a patch antenna mounted on the substrate.

25. The apparatus of claim 22 wherein the sensor means comprises:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted.

26. The apparatus of claim 25 wherein the pressure sensor means comprises:

a pressure transducer and a pressure transmitting medium disposed in contact with the pressure transducer and exposed to an air chamber in a tire on which the transponder is mounted.

27. The apparatus of claim 22 wherein the sensor means comprises:

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted.

28. The apparatus of claim 22 wherein the sensor means comprises:

means for detecting and generating an output signal for each complete 360° rotation of a tire on which the transponder is mounted.

29. The apparatus of claim 28 wherein the detecting means further comprises:

counter means, responsive to the output signal from the detecting means, for totalizing the output signals from the detecting means as an accumulated tire revolution count.

30. The apparatus of claim 22 wherein:

the processor monitors the sensor means to detect at least one of maximum and minimum values of a tire parameter over a predetermined time period.

31. The apparatus of claim 30 wherein:

the processor means stores the at least one maximum and minimum values of a tire parameter in the memory.

32. The apparatus of claim 22 wherein the receiver means and the transmitter means of the transponder communicate with interogator transmitter means and the receiver means of the control means by a radio frequency signal.

33. The apparatus of claim 32 wherein:

the processor means transmits a serial, encoded radio frequency signal containing tire condition

parameter data via the transmitter means to the control means.

34. The apparatus of claim 22 further comprising:

a housing formed of an encapsulating material encapsulating the substrate, the integrated circuit chip, the power supply, the sensor means and the antenna means.

35. The apparatus of claim 22 further comprising:

timer means, responsive to an activation signal from the processor means and connected to the sensor means, for activating the sensor means to sense a tire condition parameter only during a predetermined time period set by the timer means.

36. The apparatus of claim 35 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal received from a remote source.

37. The apparatus of claim 22 wherein the sensor means comprises at least one of:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted;

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted; and

means, mounted on the substrate, for detecting and generating an output signal for each complete 360° revolution of a tire on which the transponder is mounted.

38. The apparatus of claim 37 wherein:

the pressure sensor means includes a pressure transducer and a pressure transmitting medium disposed in

contact with the pressure transducer and exposed to an air chamber in a tire on which the transponder is mounted; and

the detecting means further comprises counter means, responsive to the output signal from the detecting means, for totalizing the output signals from the detecting means as an accumulated tire revolution count.

39. The apparatus of claim 22 wherein the sensor means comprises:

pressure sensor means, mounted on the substrate, for sensing the air pressure of a tire on which the transponder is mounted;

temperature sensor means, mounted on the substrate, for sensing the temperature of a tire on which the transponder is mounted; and

means, mounted on the substrate, for detecting and generating an output signal for each complete 360° revolution of a tire on which the transponder is mounted.

40. The apparatus of claim 39 further comprising:

timer means, responsive to an activation signal from the processor means and connected to the pressure sensor means and the temperature sensor means, for activating the pressure sensor means and the temperature sensor means to sense tire pressure and temperature, respectively, only during a predetermined time period set by the timer means.

41. The apparatus of claim 40 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal from a remote source and transmits the sensed tire pressure and temperature and a total tire revolution count from the detecting means to a remote source during the time period established by the timer means.

42. The apparatus of claim 40 wherein:

the processor means generates the activation signal separate from receiving an interrogation signal at a predetermined selectible time interval.

AMENDED CLAIMS

[received by the International Bureau on 28 July 1995 (28.07.95); original claims 1,19,20,22 and 31 amended; original claims 15-18, 23-30 and 32-42 cancelled; remaining claims unchanged; new claims 43-51 added (8 pages)]

1. In combination with a vehicle tire, a transponder for sensing, storing and transmitting vehicle tire condition parameter data comprising:

a substrate adapted to be fixedly mountable on an inner surface of a vehicle tire;

a processor means, a memory, a receiver means connected to the processor means for receiving an interrogation signal from a source remote from a tire on which the substrate is mounted, and a transmitter means connected to the processor means for transmitting a signal containing data representative of the sensed tire condition parameter to a remote source, all mounted on the substrate;

sensor means, mounted on the substrate, for sensing a tire parameter at predetermined times when electrical power is applied to the sensor means, and for generating an output signal to the processor means representative of the sensed tire parameter at each predetermined time;

power supply means, mounted on the substrate, for supplying electrical power to the integrated circuit chip and the sensor means; and

antenna means, mounted on the substrate and connected to the receiver means and the transmitter means, for communicating an interrogation signal from the remote source to the receiver means and for communicating a signal from the transmitter means to the remote source;

the memory responsive to the processor means for storing the output signals from the sensor means at the predetermined times;

the processor executing a control program stored in the memory and, in response to an interrogation signal received by the receiver means and the output signal from the sensor means, generating and supplying a signal representative of the sensor output signal to the transmitter means for transmission to a remote source.

2. The transponder of claim 1 wherein the antenna means is a microstrip antenna mounted on the substrate.

3. The transponder of claim 1 wherein the antenna means is a patch antenna mounted on the substrate.

4. The transponder of claim 1 wherein the sensor means comprises:

10. The transponder of claim 1 wherein the receiver means and the transmitter means communicate with the remote source by a radio frequency signal.

11. The transponder of claim 10 wherein:

the processor means transmits a serial, encoded radio frequency signal containing tire condition parameter data via the transmitter means to the remote source.

12. The transponder of claim 1 further comprising:

a housing formed of an encapsulating material and encapsulating the substrate, the processor means, the memory, the receiver means, the transmitter means, the power supply, the sensor means and the antenna means.

13. The transponder of claim 1 further comprising:

timer means, responsive to an activation signal from the processor means and connected to the sensor means, for activating the sensor means to sense a tire condition parameter only during a predetermined time period set by the timer means.

14. The transponder of claim 13 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal received from a remote source.

Cancel claim 15.

19. The transponder of claim 13 wherein:

the processor means generates the activation signal to the timer means in response to an interrogation signal from a remote source and transmits the sensed tire parameter to a remote source during the time period established by the timer means.

20. The transponder of claim 13 wherein:

the processor means generates the activation signal separate from receiving an interrogation signal at a predetermined selectible time interval.

21. The transponder of claim 18 further comprising:

a housing formed of an encapsulating material encapsulating the substrate, the integrated circuit chip, the power supply, the sensor means and the antenna means.

22. The transponder of claim 1 further comprising:

control means, separate from the transponder and having an interrogator transmitter means, for transmitting an interrogation signal to the processor means in the transponder, and a receiver means for receiving remotely generated signals from the transponder.

Cancel claim 28.

Cancel claim 29.

Cancel claim 30.

31. The transponder of claim 9 wherein:
the processor means stores the at least one maximum and minimum values of a tire parameter in the memory.

Cancel claim 32.

Cancel claim 33.

Cancel claim 42.

43. The transponder of claim 1 wherein:

The processor means, the memory, the receiving means and the transmitter means all formed in a single integrated circuit clip.

44. A method for sensing tire condition parameters comprising the steps of:

mounting a substrate on a tire in communication with a tire;

mounting a processor means, a memory, a receiver means connected to the processor means for receiving an interrogation signal from a remote source, and a transmitter means connected to the processor means for transmitting a signal containing data representative of sensed tire condition parameter data to a remote source on the substrate;

mounting sensor means on the substrate for sensing at least one tire condition parameter, the sensor means generating an output signal to the processor means representative of the sensed tire condition parameter;

mounting a power supply on the substrate, the power supply connected to and actively supplying electrical power to the processor means, the memory, the receiver means, the transmitter means, and the sensor means;

mounting an antenna on the substrate and connecting the antenna to the receiver means and the transmitter means; and

executing a controlled program stored in the memory by the processor means by which in response to an interrogation signal received by the receiver means via the antenna and the output signal from the sensor means, the processor means generates and supplies a signal representative of the sensor output signal to the transmitter means for transmission to a remote source.

45. The method of claim 44 wherein the step of mounting sensor means further comprises at least one of the steps of:

mounting a pressure sensor on the substrate in communication with an air chamber of a tire for sensing air pressure of a tire;

mounting a temperature sensor on the substrate for sensing temperature of a tire; and

mounting a detector means on the substrate for generating an output signal for each complete 360° revolution of the substrate.

46. The method of claim 45 further comprising the step of:

providing a counter, responsive to the output signal from the detector means, for totalizing the output signals from the detector means as an accumulated revolution count.

47. The method of claim 45 further comprising the step of:

monitoring the sensor means to detect at least one of maximum and minimum values of a tire condition parameter over a predetermined time period.

48. The method of claim 44 further comprising the step of:

activating a timer means in response to an activation signal from the processor means for activating the sensor means to sense a tire condition parameter only during a predetermined time period set by the timer means.

49. The method of claim 48 further comprising the step of:

the processor means generating the activation signal to the timer means in response to an interrogation signal received from a remote source and transmitting the

sensed tire condition parameter to a remote source during the time period established by the timer means.

50. The method of claim 44 further comprising the step of:

storing the sensed tire condition parameter in the memory.

51. The method of claim 44 further comprising the step of:

the processor means activating the sensor means to sense tire condition parameters on a predetermined selectible time interval.

STATEMENT UNDER ARTICLE 19

The amendments to claims 1, 19, 20, 22 and 31 submitted herewith are to more specifically set forth the features of Applicants' invention. New claims 43-51 have been added to specifically claim all features of Applicants' invention, without adding new subject matter.